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REVIEWS.

Ship Design and Construction.

Reviewed by D. W. TAYLOR.*

THE DESIGN AND CONSTRUCTION OF SHIPS.—By John Harvard Biles, LL.D., Professor of Naval Architecture in the University of Glasgow. Vol. I.: Calculations and Strength. London, England: Charles Griffin & Co., Ltd. Philadelphia, Pa.: J. B. Lippincott Co. Cloth; 6 × 9¼ ins.; pp. 423; 36 folding plates and 245 text illustrations. $7.50, net.

The author of this work has been for nearly twenty years Professor of Naval Architecture at the University of Glasgow—the first British university to establish a course in Naval Architecture. Before the present excellent courses were established by several universities in this country, a large proportion of the government and private students going abroad for the study of naval architecture went to the University of Glasgow and Prof. Biles has a number of former students in this country.

While Prof. Biles went to the University of Glasgow as a comparatively young man, it was after a wide professional experience—he was manager at Thomsons when that firm built the "Paris" and "New York." Since going to the University of Glasgow, he has by no means restricted his energies to the teaching of Naval Architecture, but has done much active work of a consulting nature and been a member of several important government commissions.

Volume I. of this work deals with ship calculations, including the strength of ships, but not including calculations that have to do with stability. Volume II. will take up stability, waves, propulsion, design and construction.

Volume I. is divided into three parts: Part I., of 81 pages, deals with Areas, Volumes and Centers of Gravity. Part II., of 150 pages, deals with Ship Calculations proper, such as calculations of displacement, center of buoyancy, metacenters, trim, etc. Part III., of 189 pages, deals with the Strength of Ships.

In Part I., after a little preliminary work giving definitions and general formulas, such as those for the center of gravity of a plane area, the author takes up the question of arithmetical rules for integration. Formulas are given for the application of the trapezoidal rule, Simpson's three rules and Tchebycheff's rules. Deductions of the rules are given with little comment or discussion, and it is only by inference in connection with later forms and tables that we learn that Prof. Biles, as usual with British Naval Architects, regards Simpson's rules as the standby for ship calculations, though he seems to lean here and there to the Tchebycheff formulas. The trapezoidal rule, used the world over for engineering calculations in general where it is necessary to determine the average ordinate of a curve by arithmetical methods, has never found favor with British naval architects, while their French brethren use it without hesitation.

In the United States, the British practice was universally followed until about twelve years ago when the Navy Department adopted standard forms and methods for ship calculations using the trapezoidal rule. This has resulted in some use of the trapezoidal rule by private firms in the United States, but it would seem that the more complicated Simpson's rules are generally regarded as necessarily more accurate. Examples might be cited to sustain either rule, but the truth appears to be that there are some curves, such as full midship sections, which neither rule will integrate with sufficient accuracy if applied to the uncorrected ordinates. There are other curves, such as fine midship sections and other convex sections, for which Simpson's rules applied to the uncorrected ordinates will give more accurate results than the trapezoidal, and there are still other curves, such as curves of sectional areas, where there is practically no difference between the rules. But when using the trapezoidal rule, when it is advisable to correct the ordinates to secure the highest accuracy, the necessary corrections are simple and obvious. With Simpson's rules, corrections are not so often needed, but when needed are very hard to determine. Thus, the author, on page 94, gives the corrections needed to the initial ordinates of nine curves of maximum ordinates from 8 to 10 ft. The actual initial ordinate of each curve at the origin is zero, but arbitrary initial ordinates necessary to enable Simpson's First Rule to give accurate results range from + 7.68 to — 2.64, a range slightly greater than the maximum ordinate of any section.

The Tchebycheff formulas are even simpler than the trapezoidal formula, since all ordinates are multiplied by the same factor—unity—while in the trapezoidal formula the end ordinates must be multiplied by ½. But the Tchebycheff formulas make use of ordinates unequally spaced and the spacing varies with the number of ordinates used. Their mathematical derivation is difficult, but they are not on that account necessarily more accurate than the formulas more easy to derive.

Tchebycheff's formulas are used but little, if at all, by naval architects in the United States, but it is evident from forms and tables given by Prof. Biles that they are used by some British firms for ship calculations involving longitudinal summation. They are not adapted to the types of curves involved in vertical summations.

After applying the arithmetical rules for integration to various examples for purposes of illustration, the author covers very briefly the methods of descriptive geometry needed in connection with the delineation of ship forms and lines and illustrates them by the sheer draft of a vessel. Next he describes briefly the salient characteristics of the principal types of vessels of war and commercial vessels for carrying passengers and cargo.

The development of battleships has been very rapid of late, and the author's statistical information regarding them evidently refers to vessels not of the most recent type. For instance, the statement on page 52 that "Battleships are the heaviest ships in a navy, the displacement of the largest being about 18,000 tons," is not now correct. There is no fixed condition of universal acceptance to which the nominal displacement of a battleship refers. Navy List displacements generally refer to a rather light condition, and a given ship would be given different displacements by different countries. The "Load-Draft" displacement for the most recent English battleships under construction is fully 2,000 tons less than the displacement at full load with full supply of coal, stores, etc., but even so their Load-Draft displacement is over 19,000 tons, the deep load displacement being over 21,000 tons. The latest U. S. battleships afloat and building are even larger, and other countries are also building 20,000-ton ships.

The statement on page 54 that "Modern battleships carry four large guns" is not applicable to the most recent battleships. Such vessels in England and the United States carry ten large guns, and two battleships for Brazil have been recently laid down in England to carry twelve. In fact, Prof. Biles himself, beginning on page 60, gives some information about the English "Dreadnought" under the heading "Modern Large Battleships and Cruisers," showing that this battleship carries ten 12-in. guns.

Coming to calculations proper, the author takes up "The calculations that are usually made in the drawing office after the form has been fixed and faired," such as displacement, centers of buoyancy, areas of water planes and sections, metacenters, etc. Standard forms and methods are given, there being naturally little that is novel about this portion of the work. Calculations are for the molded form—or to the inside of plating, which is regarded as an appendage. While this is usual, it is desirable, when the most accurate results are required, to make a special body plan for calculations, showing lines to the average thickness of plating.

For nearly all ships wetted surface, or the surface of the hull below water, is the most important factor in connection with resistance and standard calculations should always include its accurate determination. Prof. Biles does not touch on the matter in this volume except by an approximate formula on page 91.

The calculation of metacentric heights, etc., is very thoroughly treated, including the question of the inclining experiment for the purpose of determining the position of the center of gravity of a ship. A short chapter is devoted to the question of coefficients and standard methods of plotting results of calculations, devised by the author. After interesting illustrations of these methods for various types of vessels, descriptions are given of planimeters, integrators and the integraph.

Some years ago mechanical methods of making calculations had quite a vogue and integrators are still used to a great extent. These give not only the area of a curve, as does the planimeter, but functions from which can be determined the moment, the moment of inertia and a third-moment function. In the hands of specialists, integrators give good results, but the ordinary person finds it almost impossible to obtain the same results twice with them, except as regards area.

Prof. Biles apparently favors the integraph, which, like the planimeter, integrates areas, but in addition it plots areas as a curve is run over, which is a great advantage in many calculations.

After a short chapter on cargo capacities, and one upon the question of the effect of filling compartments and the amount of subdivision necessary for safety, Prof. Biles takes up the question of tonnage and gives the history of tonnage legislation in England. It is evident that, in England, as in the United States, when legislative bodies undertook to make tonnage laws, they were confronted by conditions, and vested rights, which made it almost impossible to pass legislation which would be consistent and logical throughout. The theory of the matter is very simple. Tonnage capacity is measured in tons of 100 cu. ft. each. The gross-register tonnage of a ship is the entire internal capacity of the whole ship in tons of 100 cu. ft.; the net-register tonnage is intended to be the net space available for cargo-carrying and other money-earning purposes. When, in order to get at net tonnage, we consider the deductions from gross tonnage on account of spaces occupied by the crew, used for navigational purposes, occupied by machinery, etc., we have a

*Naval Constructor, U. S. N., U. S. Navy Yard, Washington, D. C.

labyrinth of rules, special allowances, etc., which make the question of tonnage a very difficult one.

Vessels pay dues upon net-register tonnage, and there is a constant endeavor to so design them as to reduce the net-register tonnage to a minimum without really reducing the cargo or money-earning capacity. Prof. Biles appears to advocate that dues should be paid on the gross tonnage. This is a simple and logical idea, with much to recommend it, but legislation to this effect in any maritime country would probably meet with very strong opposition.

In a chapter on launching, Prof. Biles gives a good deal of practical information, in addition to taking up the necessary calculations. To determine the displacement or buoyancy of the immersed portion as a vessel slides down the ways, the center of this buoyancy, etc., Prof. Biles makes his calculations from successive parallel water lines which are plotted. This seems a cumbersome method and involves a great deal of unnecessary drafting and calculation as compared with the methods which make use of curves of sectional areas, commonly called Bonjean curves. Bonjean curves are exceedingly useful in connection with launching calculations and also in considering changes of trim too great to be handled by the "moment to change trim one inch" method.

Prof. Biles states that the pressure per square foot upon launching ways, meaning the average pressure per square foot upon the surface supporting the ship before the latter begins to move, should not be more than 2½ tons. This is an excellent average figure, but very successful launchings have been made in this country where the pressure was as high as three tons. Prof. Biles states, on page 227, that, using 2½ tons per sq. ft. the breadth of ways for small ships would be inconveniently small, "but there is no particular objection to the use of a greater breadth." This is perfectly true up to a certain point, but with pressures less than ½ ton per sq. ft., a ship is likely to refuse to move. The case rarely occurs, the difficulty generally being to get sufficient area of ways, but it is not unknown.

Part II., constituting nearly half of this volume, is devoted to the question of the strength of ships, which is treated quite fully. In the main treatment, there is not much that is novel, as might be expected from the nature of the case. One chapter gives quite fully the methods used and results obtained by a committee of which Prof. Biles was a member, which investigated the strength of an English torpedo boat destroyer called the "Wolf." This investigation was undertaken after a destroyer had broken in two in a seaway. The "Wolf" was actually stressed by supporting her in dry dock by various methods, the strains being measured, and she was afterwards tested in rough water for the purpose of determining how the resulting stresses agreed with those estimated and allowed for in the design. Such experiments are naturally exceedingly difficult to make and are approximate at best, but the results in the case of this torpedo boat destroyer were quite satisfactory and indicated that the methods used by the Naval Architect in determining the stresses upon ships are reasonably satisfactory. These methods are necessarily approximate since the actual stresses on a ship are due to the motion of the sea, which is highly irregular and capable of infinite variations. The standard practice in this connection, which is fully described by Prof. Biles, is to suppose the ship head on to trochoidal waves which are of the same length as the ship and of standard height 1/20 their length. It being assumed that the pressure of the water at a distance below the wave surface is the same as if the water were at rest, it is possible to determine the curves showing distribution of buoyancy for the ship in the two worst conditions: (1) when the ship is in the hollow of the wave, being mainly supported toward the ends and "sagging" in the center, and (2) when she is on the crest of the wave with the ends nearly unsupported and drooping or "hogging." Curves of weight can be established from the net weights of the ship and a curve showing the difference between weight and buoyancy is a curve of loads. From such a curve it is possible to determine curves of shearing force and bending moments. The ship herself is treated as a girder, the strength being calculated from the known dimensions and scantlings of material and knowing the shearing force and bending moment at any point, the stress is readily determined. The process is somewhat artificial, the stresses calculated as above are nominal rather than actual and values of these nominal stresses which may be safely allowed can be determined only by experience. That is to say, if, using the method above we find that a ship whose nominal stress thus obtained was 10 tons per sq. in. does not give signs of weakness in service, while a ship whose stress similarly obtained was 11 tons per sq. in. does give signs of weakness, we conclude that 10 tons is the safe limit. This process is obviously not rigorous, since, as pointed out by Prof. Biles, vessels of the same nominal strength have shown different results, some never showing signs of weakness and others showing fatal weakness. Such phenomena indicate defective material or defective arrangement of the material in the weak vessels. An additional complication in this connection is the fact that large vessels appear able to stand a greater nominal strain than small vessels.

Due to commercial conditions, there are frequently two opposing forces in connection with the determination of the strength of a vessel. The tendency of the owner and builder of the vessel is to make her as light as possible, for the less the hull weight, the greater the carrying capacity. But the tendency of the company which insures the vessel is to insist that she shall have a large margin of strength. For merchant vessels which are practically all insured in one of the large insurance societies, the strength is fixed by the rules of the societies rather than by the designers or builders.

Prof. Biles, in addition to giving fully the standard methods of determining the nominal stress on vessels, goes into the question of the differences between the real and nominal conditions. For instance, in waves, contrary to the standard assumption, the pressure of the water is not the same for all points at a given depth below the wave surface. The distribution of the actual pressure is such as to tend to decrease the stress from that resulting from the standard assumption rather than to increase it.

He also takes up the question of the effect upon the stress of heaving and pitching which do not materially affect the result. It may be remarked in this connection, that the buoyancy curves of vessels on waves could be obtained more readily from Bonjean curves than by the methods described by Prof. Biles.

Prof. Biles gives a number of results of interest showing nominal stresses on various types of vessels. The maximum nominal tension shown is a little under 12 tons per sq. in. and the maximum compression a little over 9 tons per sq. in. These are tons of 2,240 lbs. These stresses are for large vessels. Other vessels, particularly the small ones, show stresses not over 4 or 5 tons in either direction.

It is common in preliminary work to assume that the maximum bending moment for a vessel under standard conditions will be a certain fraction of the displacement multiplied by the length. This method, however, is but a rough approximation, as is evidenced by the results given by Prof. Biles for a number of actual ships, where the maximum bending moment in ton feet varies from 1/18 of the displacement in tons multiplied by the length in feet to 1/33.4 of the same quantity.

The press work of this book is excellent, there being very few typographical errors noticed. The figures and plates are also clear, although in some cases rather small.

The book could be somewhat condensed to advantage, and its value would be increased if the author had expressed more fully his own opinions and recommendations as regards some of the matters touched on. For instance, he describes planimeters and integrators without any comment as to the extent to which their use is practicable or advisable in ship calculations.

So far as Volume I. goes, it constitutes a very full exposition of the excellent course in Naval Architecture conducted by the author at Glasgow University, and will undoubtedly be of interest and value not only to young students for whom it is primarily intended, but to all who, to quote the author's words, "in their daily work are interested in the problems dealt with."

An Official British Review of Available Methods of Sewage Treatment.

METHODS OF TREATING AND DISPOSING OF SEWAGE.—Fifth Report of the Commissioners Appointed to Inquire and Report What Methods of Treating and Disposing of Sewage (Including Liquid from any Factory or Manufacturing Process May Properly Be Adopted. London, England: Wyman & Sons, Ltd. (109 Fetter Lane, E. C.). Paper, 6¾ x 10¼ ins.; pp. xii. + 238; folding tables and diagrams. 2s. 9d. American price, $1.10.

After ten full years of inquiry the Royal Commission on Sewage Disposal has submitted a report which, though it does not complete the series, may perhaps be considered as in many respects final. This report is virtually a general survey of the methods of sewage treatment now in vogue in England, with the exception of those dealing with trades wastes from individual industrial works. A further report will deal with such wastes, and also, we presume, with some yet unfinished investigations on "the effect of discharging effluents of known composition into streams, with a view to reporting more fully on the question of standards and tests." A further report, we also presume, may be expected on some experiments now in hand, on the fertilizing value of sewage sludge, and perhaps on some other topics still under consideration.

The main conclusions and recommendations of the report now before us were printed in Engineering News of Oct. 8, 1908. The full report takes up in considerable detail the various points touched upon in the summary, and, based as it is on the examinations of scores of witnesses, the studies of many municipal sewage-treatment plants, and the special tests made for the Commission, the report forms one of the most valuable reviews of sewage treatment that have ever been published.

The report is divided into eight parts. The first deals with preliminary treatment, or the removal of suspended matters, and takes up screens, detritus, sedimentation and septic tanks, as well as chemical precipitation. A section of this first part is devoted to the relative cost of preliminary processes, and another to the choice of tank treatment. The second part deals with "artificial filters," which are here divided into contact beds and percolating filters. Here, also, relative costs and efficiencies are discussed. Part III. has to do with land treatment, and in it the same general plan is followed as has been noted for the other parts. The fourth part takes up sludge. Part V. deals with a variety of topics, including the effect of trade effluents on sewage purification, nuisance from smell at sewage works, choice of a method of sewage treatment, the treatment of storm-water sewage, and separate and combined systems of sewerage. Part VI. discusses standards and tests; Part VII. consists of a few lines on the pollution of estuaries and tidal waters; Part VIII. summarizes the four earlier reports of this Commission, and presents the general conclusions which, as we have already stated, were printed in our issue of Oct. 8, 1908.

The report deals, as adequately as could be expected, with all the systems of treating municipal and domestic sewage now in use throughout the civilized world, if we exclude intermittent filtration, as understood and practiced in America, and the disinfection of sewage or sewage effluents by germicides. Intermittent filtration is in part included under land treatment in this report, but is designated as land filtration rather than intermittent filtration and, as used in the report, rarely means little except broad irrigation without cropping. Sewage disinfection can scarcely be classed as a system of treatment as yet.

Besides strongly recommending that every one who desires to thoroughly understand modern

methods of sewage treatment should obtain and carefully read this valuable report, it seems unnecessary to say anything further regarding it here, except to call particular attention to the broad general conclusion of the Commission that any one of several methods of sewage treatment now in vogue will produce satisfactory results, so that the choice between methods is one of the degree of purification required and other local conditions; and that there is great need in England for a central authority to have control of all sewage-disposal matters. Such a central authority would establish general standards and would serve as a court of appeal from proposed rivers boards having primary jurisdiction in each of the several drainage areas of the country. The rivers boards, it may be added, would be expected to recommend to the central authority modifications of the general standard set for the purity of the effluent from sewage works, these modifications being designed to suit local conditions.

English Text of a German Book on Oil Motors.

Reviewed by LIONEL S. MARKS.*

OIL MOTORS.—Their Development, Construction and Management. A Handbook for Engineers, Owners, Attendants, and All Interested in Engines Using Liquid Fuel. By G. Lieckfeld. London, England: Charles Griffin & Co., Ltd. Philadelphia, Pa.: J. B. Lippincott Co. Cloth; 6 × 9¼ ins.; pp. 272; 306 illustrations, mostly in the text. $4.50, net.

An examination of this book leaves one with some doubt as to the author's general intentions. On the title page it is described as "a handbook for engineers, owners, attendants and all interested in engines using liquid fuels;" it is obvious on inspection that some attempt has been made to adapt the book to the assumed requirements of these diverse persons, but the point of view of the engineer who may be assumed to know something about the theory and practice of machinery is necessarily so different from that of the owner, who cannot be expected to have any such knowledge, or of the attendant, whose knowledge of the theory may be a negligible quantity, that it is practically impossible that one book should serve all of them satisfactorily. In endeavoring to serve three masters at one time, all three have been scantily and to some extent unsatisfactorily treated.

Notwithstanding this primary defect—or perhaps on account of the wide field which it endeavors to cover—the German book, "Die Petroleum-und Benzinmotoren," of which this is a translation, has gone through three editions, dated 1895, 1901 and 1908, respectively. The German title suggests one important difference between the conditions in Germany and in this country in the use of oil engines. Whereas we have practically but one source for our liquid fuels, namely, petroleum (for alcohol is not commercially valuable as yet), there are three sources in Germany: petroleum, the coal tar product benzol or benzine, and alcohol. In the formation of illuminating gas from coal only about one pound of benzol is obtainable per ton of coal, but in by-product coke oven plants about fourteen times as much benzol is collected. In 1906, 154,000,000 lbs. of benzol were produced in Germany. Its calorific value is about the same as that of gasoline—its cost (about $2.50 per 100 lbs.) is considerably less than that of gasoline ($4 per 100 lbs.). Alcohol, at $1.60 per 100 lbs., and having but little more than one-half the calorific value of gasoline and benzol, lies between the two in cost on a heat unit basis.

The first two chapters of the book are devoted to a somewhat general discussion of the three liquid fuels just mentioned. The third chapter takes up the historical development of "petrol and paraffin motors." The rendering of Benzin- und Petroleummotoren by "petrol and paraffin" motors is not in accordance with normal practice. By "petroleummotoren" is meant those engines which use heavier oils, such as kerosene and crude oil, and which we call "oil engines"; "benzinmotoren" are usually called "petrol motors" in England and "gasoline engines" in this country. The "petrol" engines considered are the Hock (Benoir Cycle), Brayton, Wittig and Hees, and the Daimler; the "paraffin" engines are the Kjelsberg, Capitaine, Hornsby-Akroyd, and Diesel; in each case there is a description of the construction and method of operation.

The fourth and fifth chapters deal with the construction of the component parts of modern engines: cylinders, pistons, valves, fuel supply, carburetters, vaporizers, fuel pumps, heating lamps, governors, starting devices, lubrication, and ignition apparatus. The illustrations are satisfactory, the treatment of carburetters and ignition is good so far as it goes.

Chapters 6 to 8 give numerous examples of stationary, automobile, ship, boat and air-ship engines. Drawings are given of most of the engines, although in some cases there are only external photographic views. There is practically no descriptive matter, other than the explanation of reference numbers on the drawings; in each case there is a table of the horse-powers for which that particular engine is built, the cost, weight, and external dimensions. The engine speed and cylinder dimensions are not given. The stationary engines included are the Körting, Deutz, Swiderski, Oberursel, Gardner, Tangye, Söhnlein, Bánki, Diesel and Trinkler; the automobile engines Benz, de Dion-Bouton, Canello-Dürkopp, Adlerwerke, Daimler, Hexe, Bayard, Swiderski, and others; the boat engines Daimler, Sleipner, Deutz, Gardner, and others. Nearly all these engines are of German design and German make.

Chapter 10 is devoted mainly to pictures of various applications of oil engines to road and rail vehicles, to boats and air-ships, to agricultural purposes and other industrial and constructional works. Chapter 11 has various generalities about the erection and attendance of oil engines, and the German fire-protection regulations. The final chapter deals with oil-engine troubles.

Throughout the book there is nothing of theory. The work is descriptive and gives evidence of practical experience by the author. It is not a work for one whose interest in the oil engine is principally on the technical side. The method of action of many of the engines is not explained, as, for example, the complicated Trinkler engine, or the Banki engine with its water injection. In this respect the present work is not as good as the second German edition.

The name of the translator is not given. His work has not been done particularly well.

*Assistant Professor of Mechanical Engineering, Harvard University, Cambridge, Mass.

MASONRY AND REINFORCED CONCRETE.—A Working Manual of Approved American Practice in the Selection, Testing and Structural Use of Building Stone, Brick, Cement, and Other Masonry Materials, with Complete Instruction in the Various Modern Structural Applications of Concrete and Concrete Steel. By Walter Loring Webb, Author of "Railroad Construction," etc., and W. Herbert Gibson. Chicago, Ill.: American School of Correspondence. Cloth; 6¼ × 9¼ ins.; pp. 444; plates, and 236 text illustrations. $3.

As we have many times before stated in reviews of the various books which go to make up the "Cyclopedia of Civil Engineering," the titles are too ambitious, not to say misleading. As a general survey of the field of masonry construction—including that latest development, concrete—this book by Messrs. Webb and Gibson is quite satisfactory. It will make very interesting reading for the novice anxious to gain an idea of the principles of the subject before taking up its serious and detailed study. But it is not a "working manual" nor does it contain "complete instruction in the various modern structural applications of concrete and concrete steel."

AUDEL'S GAS ENGINE MANUAL.—A Practical Treatise Relating to the Theory and Management of Gas, Gasoline and Oil Engines, Including Chapters on Producer Gas Plants, Marine Motors and Automobile Engines. New York: Theo. Audel & Co. Cloth; 5¼ × 8¼ ins.; pp. 469; 156 illustrations, mostly in the text. $2.

The opening chapter of this book presents a brief but fairly complete record of the history of the gas engine. The remainder of the book falls naturally into four main divisions, taking up, respectively, the theory, design and details of construction, testing and operation of gas, gasoline and oil engines. The last two chapters, "The Automobile" and "Useful Rules and Tables," are in the nature of an appendix.

That portion of the text which deals with thermodynamic principles is rather incomplete and disappointing, and is characterized by loose or inexact statements which might easily confuse anyone not already familiar with the subject. The balance of the book is comparatively exempt from this criticism. The descriptions of various specific engines of all types, including the more recent developments, such as the Diesel engine and the high-powered, double-acting engines operating on blast furnace gas, constitute a particularly noteworthy feature. These descriptions occupy a considerable portion of the book (Chapters XV. to XXI., inclusive) and are accompanied by adequate line-cut illustrations.

The object of tests on gas engines and producer plants is briefly discussed and a very general statement made of the principal things to be determined. There is in this section of the book a chapter describing the instruments used in testing and explaining their use. The necessary computations are indicated by formulas. The last section of the book takes up the subject of lubrication, general care of an engine and precautions to be observed in its use. Considerable space is devoted to naming the symptoms and explaining the cure of what might be called gas engine diseases. The chapter on automobiles points out the special requirements for their engines and discusses the transmission, clutch and related mechanisms.

While deficient in the matter of theoretical, or thermodynamic, information, and therefore not complete as a text-book on the subject, this volume presents in a convenient form a large amount of practical information.

FOWLER'S MECHANICS' AND MACHINISTS' POCKET BOOK AND DIARY, 1909.—A Synopsis of Practical Rules for Fitters, Turners, Millwrights, Erectors, Pattern Makers, Foundrymen, Draftsmen, Apprentices, Students, etc., etc. Edited by William H. Fowler, M. Inst. C. E., M. Inst. M. E., etc. Manchester, England: Scientific Publishing Co. Boards; 3¾ × 6 ins.; pp. 448; numerous illustrations in the text. 6d., net; American price, 20 cts.

Nearly simultaneous with the appearance of Colvin and Stanley's "American Machinists' Handbook" (reviewed in our October Supplement) comes this latest of the Fowler English pocket books. The matter contained in the book can be pretty generally classified as tabulated data or summarized practice—British, of course. The former consists of mathematical tables, properties of materials, dimensions and characteristics of machines and small apparatus. The second classification would take in elementary mathematics, properties of materials, the design of machine tools and accessories, the drilling, boring, grinding and general working of metals, shop practices, such as polishing, coloring, hardening, annealing and pickling, pattern making, gear designing, belt and rope driving, etc., etc.

OREGON CONSERVATION COMMISSION.—Report to the Governor, November, 1908. (J. N. Teal, Chairman.) Paper; 6 × 9 ins.; pp. 123; folding plates and text illustrations.

This report, it is to be hoped, will prove to be one of many similar ones soon to be issued by state conservation commissions as a result of recent national and other agitation for the conservation of the natural resources of the country. Oregon has the honor, so far as we know, of being the first state in the field with such a report. The report deals in considerable detail with the conservation possibilities and problems of Oregon. Cooperation with adjoining states, particularly in matters pertaining to the Columbia River drainage, and also cooperation with the general government, is urged. Some physical data are given, and the very great need for securing more data is emphasized.

QUEBEC BRIDGE INQUIRY.—Royal Commission, 1907. (Henry Holgate, Chairman.) Vol. II. Minutes of Proceedings and Printed Exhibits. Ottawa, Can.: Pub. Doc. (Sessional Paper No. 154). Cloth; 6½ × 10 ins.; pp. xxii. + 585; numerous plates of photographs and drawings.

The testimony in the matter of the Quebec Bridge collapse before the governmental commission is now available in printed form. It is an absolutely necessary supplement to the Com-

mission's formal report, to one who desires to make a full study of the accident and reach a full understanding of the Commission's conclusions or criticisms. It is to be hoped that copies are available for general distribution; we would suggest that engineers interested make application to the Minister of Railways and Canals, Ottawa.

Mine Surveying Underground.

Reviewed by LOUIS D. TRACY,* Assoc. M. Am. Soc. C.E.

A MANUAL OF UNDERGROUND SURVEYING.—By Loyal Wingate Trumbull, Consulting Mining Engineer. New York and London: Hill Publishing Co. Cloth; 6 × 9¼ ins.; pp. 251; 94 illustrations, mostly in the text. $3, net.

The treatment of mine surveying in the ordinary text-book is so brief and elementary as to be of little value. By devoting some 200 pages to underground surveying, Mr. Trumbull has been able to treat the subject in detail and to produce a book of real value to engineers. The author states frankly that much of the material is compiled from various sources, but he has brought together in one book much useful information which the young engineer could find only by diligent search among various periodicals and reference books.

The first chapter, containing a history of the development of the transit, seems out of place in a book of this kind. The matter on the adjustments of instruments is from the catalog of a well-known maker and might also well be omitted, especially as it is far from satisfactory. The explanation of the methods of determining a meridian in the second chapter is also rather unsatisfactory. By omitting everything in the first 91 pages that is not especially pertinent to mine surveying, and by a more adequate treatment of that which is, the first part of the book would be improved. In the remaining 155 pages of the book, the author is to be commended for confining himself strictly to his subject.

Chapter III. treats of underground practice in the handling of instruments, referencing survey points and various time-saving devices, and is very good and contains many helpful suggestions.

Chapter IV. is one of the best in the book, as it contains nearly all of the practical methods for transferring surface meridians to the work below, both by drifts and by shafts. This is very important in mine surveying, as upon its accuracy depends the value of all future work.

The part of the book (Chapter V.) describing the surveys for rooms and stopes is not so clear, especially to one not thoroughly familiar with metal mines. A short description of the general plan of a metal mine, together with a definition of the various technical terms, would have been very beneficial. The general instructions regarding mine sampling are very useful to those who are obliged to obtain samples of coal or ore.

Chapter VI. is a brief commentary upon the subject of systematic note-keeping, which emphasizes at the same time the importance of keeping all calculations in such form as to be easy of access.

Chapter VII., on the uses of Mine Maps, is a very valuable chapter, and one that might be read with profit by those mine managers who are inclined to scoff at all scientific methods, and who refuse to learn, usually stating that they have been "working long enough to know." A feature of this chapter is a digest of the laws relative to mine surveying in several of the states, and of the requirements in England and Germany. The latter part of the chapter, upon assay maps, is not clearly written and the references to the figures are evidently incorrect.

The next chapter explains the making of mine maps. The various methods of plotting, which differ little from those used for surface maps, are taken up and compared as to their accuracy. This chapter is followed by one upon the preservation and care of maps, a description of blue printing, etc. A system of map filing is suggested which is very good, together with a description of mine models made from glass, wire, etc.

A chapter on bore hole surveys gives some very ingenious methods of measuring the inclination and length of the drill holes.

Chapter XI., perhaps the most important in the book, is a compilation of the methods used by various coal and metal-mining companies. It takes up very fully the detailed operations involved in running lines through inclined shafts, stopes and drifts, and gives many illustrations of keeping notes, marking stations and recording side notes. In addition, there are descriptions of actual surveys made under very adverse circumstances. It is a very complete treatment of mine surveying and cannot help being of great value to any one engaged in this class of work.

The last chapter contains a large number of questions for examinations as U. S. Deputy Mineral Surveyor. Problems are also given bearing on the grades of drifts in respect to the dip of the vein, intersection of veins with shafts and many others of similar nature.

It might be stated that some of these questions and problems have no corresponding treatment in the text, and a chapter might be added on work of a special nature suggested by these questions and problems.

One feature of this book is the number of references given at the end of each chapter to different articles pertaining to the subject of that chapter. This places the reader at once in touch with additional material.

The scope of the book might also be enlarged to include a chapter on staking out mining claims, an important part of a mining engineer's duties, which is not adequately treated in text-books and not at all in this book. With these additions, the book would be most complete, and well worth a place in the library of any one connected with the development of metal or coal mines.

*Civil and Mining Engineer, 245 Fourth Ave., Pittsburg, Pa.

Three Foreign Books.

HANDBUCH UEBER TRIEBWAGEN FUER EISENBAHNEN.—Prepared by C. Guillery, at the order of Der Verein Deutscher Maschinen-Ingenieure. Munich and Berlin: R. Oldenbourg. Cloth; 6½ × 9½ ins.; pp. 202; 93 illustrations in the text. 7½ marks; American price. $3.

DIE STATIK DES KRANBAUES.—By W. Ludwig Andrée. Munich and Berlin: R. Oldenbourg. Cloth; 6½ × 9½ ins.; pp. 220; 380 illustrations in the text. 8 marks; American price, $3.20.

CHRONOMETRIE.—By J. Andrade. Part of "Encyclopédie Scientifique," published under the direction of Dr. Toulouse. Paris, France: Octave Doin. Cloth; 4½ × 7¼ ins.; pp. 382; 193 illustrations in the text. 5 francs; American price, $1.50.

Mr. C. Guillery, of Munich, has produced a very commendable descriptive monograph on Railway Motor-Cars, the first book of the kind that has come to our notice. Besides having the advantage of novelty, the work possesses the merits of accurate and thorough text in the purely descriptive portions and good judgment of the subject-matter in the discussion of the various machines, together with the equipment of an abundance of good drawings. Railway motor-cars are not at all new, so that the author needed to cover quite a period of years: the first motor-cars were English, being designed and built by Samuel (1847), Adams (1848) and Fairlee (1868), while continental Europe entered the field in the late 70's. Nor is the field as small as the very scanty development in the United States might suggest. Europe has not only a large number, but also a great variety of types of motor-cars, owned by railways in every one of its countries. In a few cases they are even relied upon for nearly all of the service, notably on the Arad-Csanád standard and narrow-gage lines in Hungary. The recent revival of the storage-battery car on the Prussian railways also testifies to the active development of motor-cars in Europe. The United States have a place of note in the motor-car register only because the largest and most powerful cars have been built here: the gasoline cars of the Union Pacific Ry. The contrast between America and Europe in motor-car matters, together with the fact of our great mileage of railways and the extreme variations of traffic density, suggests that we may yet see a large extension of motor-car operation. Perusal of Mr. Guillery's book certainly supplies no arguments against such a belief, nor against the expectation that the movement would be profitable.

Whether a work on Statics of C[ran]es can justify its existence may well be qu[es]tioned. The principles to be applied in designing supporting framework of any one of the [mul]tudinous forms of cranes are completely co[ve]red by the principles on which bridge design [is] based, and though the detail application of the principles in working out a complete design [has] some special treatment, this does not affe[ct] the statics of the matter. Andrée's "Statik des [Kran]baues," however, concerns itself primarily w[ith] this elementary phase of the subject. It giv[es a] considerable number of examples of crane b[ri]dges, runways, towers, etc., and for each work[ed] out in detail the procedure of stress computa[tion] (either exact or approximate, the latter in s[ome] minor cases statically indeterminate combinations). In connection with this, it is true, some [of] the special modifying factors of crane desig[n] also receive attention, though only incidentally. This fact, together with the variety of the [str]uctural combinations which are represented in the book, may make it useful to an occasional American reader. On the whole, however, there does not seem to be adequate reason of necessity for the book, in view of the great bulk which the really necessary literature of engineering has attained to-day. The work possesses the insinuating graces of first-class typography and illustrations.

The high-grade miniature machine which every person makes use of more often than any other piece of machinery—the clock or watch—deserves to be studied with care by all who interest themselves in mechanical engineering. To be familiar only with the general operating relation of the main parts of a watch, as power element, gearing, and governor, is to ignore all the advance of the clockmaking art after its first beginnings. Nowadays, when anyone may buy a watch-movement that will vary only half a second in a day, few realize that not so long ago a national prize for constructing clocks capable of this accuracy was contended for during years by the most skilful designers and makers. The difficulties which had to be solved before the wonderfully accurate timepieces of modern times were produced are not the less interesting because they are concerned with infinitesimally small actions. Their study is both engaging and instructive. "Chronométrie," by J. Andrade, a very clearly written French monograph on the theory and construction of timepieces is a good text for such study. The author opens his theme very clearly by emphasizing that the whole problem of the clock is in the regulating element, all other parts being very commonplace auxiliaries. He then develops the historical evolution of regulators—pendulum or balance-wheel and escapement—from simple to complex, and explains the theory of actions and disturbances in a similar progression from elementary to refined theory. Descriptions of the principal devices are, of course, included. In so small a book obviously it is not possible to cover the subject with the thoroughness of a treatise, but for the purpose of study by one who is not personally concerned in watchmaking this is unnecessary. If anything will be found lacking it is the matter of materials and the matter of mass manufacture, with discussion of influence as well as methods. But this, perhaps, would itself require a separate work larger than the present one.

CONCRETE.—Its Uses in Building, from Foundations to Finish. By Thomas Potter. Third edition, revised and enlarged. London, England: B. T. Batsford. New York: D. Van Nostrand Co. Cloth; 5½ × 8¾ ins.; pp. 328; 138 illustrations, mostly in the text. $3, net.

To those concrete engineers, and there are many in this country, who think that concrete as a building material was not used extensively until the last decade, this book should be commended. Its first edition was published in 1877 and many of the processes and systems described in the latest edition are retained from that time. In addition the history of the use of the material in ancient times and more particularly in England the middle of the last century is very complete. Mr. Potter is a builder of some 40 years standing and during that time he has used concrete in the construc-

tion of buildings, both in blocks and in solid, continuous walls. In the description of these details the book is very good; it should have considerable value for the small builder of straight concrete work. There is an attempt to enter somewhat into the matter of the theory of concrete mixing and designing and a slight reference to reinforced concrete, but this portion is quite evidently out of the author's scope and of very little value.

The Sanitation of Rapid Transit Subways.

Reviewed by CHARLES F. McKENNA.*

THE AIR AND VENTILATION OF SUBWAYS.—By George A. Soper, Ph. D., M. Am. Soc. C. E. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¼ × 8¼ ins.; pp. 294; 44 illustrations in the text. $2.50; English price, 10s. 6d., net.

Some foolish statements of a physician blundering with an apparatus for determining carbonic acid appeared in the press shortly after the opening of the New York Subway and alarmed the public. It was told that there was only 11% of oxygen in the air of the new tunnel, and that carbonic acid was present in so great a quantity that death threatened any one who stayed long enough in the polluted place.

It did not occur to this experimenter to reconcile his results with the fact that the employees had for some time been working long hours below and had seemed still hearty and healthy.

Ultimately, as a result of the discussion aroused, the author of the work here reviewed was retained as an expert to study all the characteristics of the air in the subway. His work was well done. This volume summarizes 2,000 pages of his data, and includes valuable studies of other subways in this country and in Europe, as well as excellent statements of the underlying principles upon which air of enclosed spaces should be investigated, particularly when occupied by lung-breathing animals, which, of course, includes the subway hog.

The opening chapter gives good descriptions in brief of the conditions of important subways used for passenger transportation throughout the world, which enable one to understand better the comparisons made afterwards. For example, the Metropolitan of London is close to the surface. The other London tunnels are from 40 to 150 ft. below the surface. The Paris, Berlin and New York subways are close to the surface.

After treating of the characteristics of normal air, particularly of cities, there is some discussion of the methods of procuring such air for subways, and particularly of the use of fans for the ventilation and availing of the piston action of trains. The investigation of the air of the New York Subway would seem to indicate that this last-named action is greater in this tunnel than we would be led to believe from a mere observation of its open cross-section. The addition of blow-holes to the already extensive openings of stairways seems to add materially to the ventilation, despite the dissipation of the air currents in eddies about the trains.

The particular features investigated in the air were temperature, humidity, odor, bacteria and dust. A great number of determinations of carbonic acid were made, both upon the street and below, and the results would seem to indicate that the chemical condition of the air as regards carbonic acid is closely parallel to the condition in the streets, a weekly average showing usually 3½ parts per 10,000 of carbonic acid in the air of the streets, and most often the subway air containing one part more per 10,000. Strange to relate, the results in the Paris close-to-the-surface subway are not nearly so good, for we find in the Metropolitan Railway of Paris the carbonic dioxide is only just below 9 parts per 10,000, and some times as high as 16. The construction of blow-holes produces a reduction of this in their vicinity from 9.2 to 6.8, from 9.5 to 6.4, from 10.3 to 6.1, from 11.4 to 6.5. We would assume an atmospheric condition above stairs of not over 4.

The conclusion of the author's study of the air in the New York subway is that it is satisfactory. This does not apply always to the air in the crowded cars. The heat and humidity of the subway in summer time are practically the only objectionable features. It is probable that the serious complaints in the fall and winter of 1904-5, after the opening, were due to the strange but not offensive odors, and to the nervousness of weak-hearted passengers who might possibly have had their breathing or heart action affected psychically. It is certain now that the air is renewed with much freedom, and that more blow-holes would still further improve these conditions.

There were only half as many bacteria found in the air of the subway as in the air of the streets after 3,000 determinations, and most of these bacteria came from the streets.

The author seems to find much significance in the amount and character of iron dust particles, and his chief recommendations regarding the health of the employees in the New York Subway look to that element as a protection for them. It would perhaps not have been out of place if the author had thundered against the spitting nuisance and the undesirable citizen who strikes his matches and lights his cigarettes or cigars immediately upon leaving the cars, regardless of the rights of his neighbors to pure air.

Some little errors may be pointed out if it should be necessary to indicate them before another edition is printed. On page 76, carbonic acid and carbon dioxide appear to be used as diverse terms, and a second time on the same page appears the same error in this paragraph: "Carbon dioxide, due to imperfect combustion of coal, was present in very appreciable quantities. Usually there was one part of carbon dioxide to 13 parts of carbonic acid (as impurity). This proportion was fairly constant."

THE AMERICAN COLLEGE.—A Criticism. By Abraham Flexner. New York: The Century Co. Cloth; 4½ × 7 ins.; pp. 237. $1, net; postage, 7 cts.

It is gradually coming to be comprehended by the American public that something is the matter with our much-vaunted system of higher education. With all the changes and innovations that have been introduced in colleges and schools during the past quarter of a century, each and all of them supposedly in the direction of advance, it is quite doubtful whether the boys and girls in the secondary schools and in the colleges at the present day are receiving as thorough an education on the whole as those did who were in the same institutions twenty-five or forty years ago. There has been much discussion of this subject in newspapers and magazines, and many deliverances by high educational authorities; but the book before us is, so far as we recall, the most keen and searching analysis of the actual present status of our educational system that has anywhere appeared. While the subject of the book is primarily the training which the American college ought to give, but does not give at the present time, a most important feature of the book is its showing of how the mistakes of the college have paralyzed the work of the secondary schools. We earnestly urge a careful reading of this book by every one of our readers connected with the teaching staff of the engineering schools. While the author is writing chiefly of the courses that lead to the A.B. degree, yet much that he says has a definite bearing on the problems with which the engineering schools have to deal.

One of the chief criticisms which Mr. Flexner makes of present-day college work is that our college faculties are giving their chief energies to research work rather than to instruction. We are not at all sure that a similar indictment might not be brought against some of our technical schools.

As evidence of the broad viewpoint of Mr. Flexner, it may be noted that he has little respect for the old-time classical curriculum. He refers, with contempt, to the proposition to resuscitate the compulsory study of Latin or Greek to the day of graduation. He declares that the classical curriculum went to pieces because it had long since served its purpose. He shows that our conditions are not those of foreign countries, and that social conditions here do not warrant even that survival of classical study which still remains abroad.

While Mr. Flexner devotes much space to the defects of the elective system, he has no respect for the opposite extreme of purely disciplinary instruction. He says of this:

> Sheer discipline, whether of the classical or any other kind, cannot give us the type of educated man that modern society wants. I say it leads nowhere; it does not connect individuals with concrete opportunities. I do not mean this formula to exhaust the province of college education; but so much at least a college education must do. The classical discipline can take no account of this central fact. It goes its way regardless of particular situations. It tends therefore to the over-production of educated men whose training leaves them high in the air without a parachute to get to earth in.

In his final chapter, "The Way Out," Mr. Flexner pleads for a radical revision of our college courses. He urges that our great institutions of higher education should again give their chief energies to the training of undergraduates and to training them in a way that shall best develop them and best fit them for real life. To show that other high authorities on education are equally convinced with Mr. Flexner that our educational program needs radical overhauling, we may quote from a recent address by President Alderman, of the University of Virginia. In a speech at Washington in December, before the Southern Commercial Congress, he declared that much of the time spent under the present school system is wasted and that young men ought to be turned out of the colleges and professional schools at least four years younger than is at present possible.

In conclusion, we urge the reading of Mr. Flexner's book also upon any and all of our readers interested in any way in educational matters. It seems evident that our educational development in the past has been left too much to those who had pet hobbies to ride.

ENGINEERS' POCKETBOOK OF REINFORCED CONCRETE.—By E. Lee Heidenreich, M. Am. Inst. M. E. Chicago and New York: The Myron C. Clark Publishing Co. London, England: E. & F. N. Spon, Ltd. Flexible leather; 4½ × 6¾ ins.; pp. 304; 164 illustrations in the text. $3, net.

On account of the unsettled standards and the incomplete knowledge of concrete construction, handbooks for the industry have not been particularly satisfactory. They have had too much of controversy and too little of fact, which latter, so clearly and completely presented that the book, on occasion, can be substituted for a large library, is all that is required of a handbook. Mr. Heidenreich's pocket-book is nearer this ideal than any on the same subject heretofore published, largely because the author realizes the constantly changing standards of the industry and offers his book as a snapshot, so to speak, of the present stage, to be revised with the development of the art. It is necessarily incomplete, but it has compactness, good arrangement, clearness and a fair selection, all valuable attributes of the good handbook.

The chapter headings are: Material and Machines; Design and Construction of Buildings; Design and Construction of Bridges; Abutments and Retaining Walls; Culverts, Conduits, Sewers; Pipes and Dams; Tanks, Reservoirs, Bins and Grain Elevators; Chimneys, Miscellaneous Data, Cost Keeping, Estimating, Specifications, etc. Of all these, the chapters on buildings and on pipes, culverts and sewers are by far the best; in these works the author seems to have had the most experience. The chapter on bridges treats only the elastic arch, and that not at all satisfactorily, and includes some very incomplete notes on construction.

LABORATORY NOTES ON INDUSTRIAL WATER ANALYSIS.—A Survey Course for Engineers. By Ellen H. Richards, Instructor in Sanitary Chemistry, Massachusetts Institute of Technology. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5⅝ × 9 ins.; pp. 49. 50 cts., net.

These notes are in the nature of five laboratory exercises, to determine first the industrial characteristics of water in general and then the amount of scale-forming materials, iron, sulphate, alkalinity, etc. The fifth exercise deals with remedies. Besides the five laboratory exercises, there is a second part, which takes up standard solutions and gives some valuable con-

*Consulting Chemist and Chemical Engineer, 50 Church St., New York City.

version tables. A few bibliographical references conclude the book. Obviously, the book is intended for those who already have a considerable knowledge of chemistry and some experience in chemical analysis. As many of our readers are aware, the author is so well known as an experienced and highly competent instructor, investigator and writer, that no words of commendation of this addition to her large list of admirable books are necessary.

Accounting, Auditing and Bonds.

Reviewed by FREDERICK A. CLEVELAND.*

ELECTRIC RAILWAY AUDITING AND ACCOUNTING.—By William H. Forse, Jr., Vice-President American Street and Interurban Railway Accountants Association, Treasurer Indiana Union Traction Co. New York: McGraw Publishing Co. Cloth; 6 × 9½ ins.; pp. 157; 48 illustrations in the text. $2, net.

ACCOUNTING PRACTICE.—By Clarence Munro Day. New York: D. Appleton & Co. Cloth; 6½ × 9½ ins.; pp. 312. $6, net.

INVESTMENT BONDS.—Their Issue and Their Place in Finance. By Frederick Lownhaupt. New York: G. P. Putnam's Sons. Cloth; 6 × 9 ins.; pp. 253. $1.75, net.

Mr. Forse's work is one of the few books that has been written on the subject of railway accounting which is both scientific in its treatment and may be used as a guide in accounting practice. Every branch of the service has been covered, including construction as well as operation accounts and statistics. Accounting theory is not discussed but applied, and in application is sound. The broad experience of the author as accounting and executive officer shows in every line. If there is any criticism to be offered it would go to brevity of statement. The author states procedure and describes methods with great conciseness, covering every point, but presuming in the reader thorough familiarity with the accounting principles which are applied. Strictly speaking, the work may be said to be for the accountant rather than for the bookkeeper or elementary student. Taking the somewhat limited field of electric railway accounting, the breadth of activities covered comprehends nearly every relation entered into by steam railroads as well. Freight and express accounts, baggage, interline tickets and baggage, interline freight accounting, station records and accounts, station audits, damage claims, purchasing and stores accounts, shop records, amusement park accounts, voucher disbursements, the payroll, interest, taxes and dividends, additions and betterments, car miles, car hours and other units, reserves and sinking funds are among the subjects discussed which are applicable to both fields.

As suggested by the title, Mr. Day's contribution is designed to serve the purpose of a field book of accounting as distinguished from a treatise on accounting theory. Part I. is descriptive of the methods of making an audit, adjusting the books, preparing the accountant's report, and planning a general system of accounting records. Part II. deals with planning and installing cash accounts. Part III. is composed of drafts of typical accounting forms and documents. Part IV. describes and illustrates reporting forms. While the first few pages contain elementary commonplaces, the contents generally reflect the experience of a practitioner. The form of address is one adapted to make the subject clear to the student. The author has been systematic is his treatment, if not comprehensive. As related to accounting practice, the work is to be considered as elementary rather than as a working guide to an accountant of broad experience. Its place in an accountant's library is more largely for the use of the clerk or junior than for the senior and principal. The technic is well worked out and the suggestions will be most helpful to those who have not already developed a method or technic through which reliable auditing and critical results may be obtained. It fills a place in accounting literature not before occupied.

Mr. Lownhaupt points out that to this time there has not been available a book in which could be found a comprehensive classification and an adequate description of the processes of issue and negotiation, the physical and legal attributes, the financial relations and significance of investment bonds. In this essay the field is now broadly covered. The classification is exhaustive and is well correlated; description is clear and concise, showing careful work and much pains in bringing together information which will be valuable to the student. The legal and financial relations are ably discussed, although at some points they may be said to be stated somewhat too broadly, conveying impressions which may require further reading or experience to correct. For example, the feature of a bond which distinguishes it from a promissory note is said to be "length of life" (p. 7). It is asserted that consideration of the question of legality "has no place in the study of government obligations." "Bonds of all other than public corporations [municipal] are unaffected by this question" (p. 66). Greater force would have been given to the point if stated with less positiveness. The treatment given to the subject in some parts is less effective than it would be if the textual matter were better organized: that is, it does not readily yield to analysis. These, however, are not serious defects. The informational value of the contribution must give it a permanent place in the literature of finance. The essay will be found useful in the class room. It will also make a strong appeal to that large class of young men who, during the business hours of the day, are occupied with the routine of office and financial work, but who, in some of their leisure time, seek to obtain a broader view and a better basis for the exercise of judgment—the young men who will fill a large part of the important business positions of the future.

*Bureau of Municipal Research, 261 Broadway, New York City.

Hutton's Steam Power Plants Revised.

THE MECHANICAL ENGINEERING OF STEAM POWER PLANTS.—By Frederic Remsen Hutton, Professor Emeritus of Mechanical Engineering in Columbia University, Past President and Honorary Secretary of the American Society of Mechanical Engineers. Third edition, rewritten. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 825; 697 illustrations, mostly in the text. $5; English price, 21s., net.

Prof. Hutton's book as rewritten aims to give first a broad survey of the functions and general assembly of a power plant. To that end his first discussions are on the thermal inter-relation of the various pieces of main and auxiliary apparatus. This done, he passes to "an analytical study of details." If we except the general and introductory parts, the rest of the book falls into two groups of topics. First are those on the boiler plant and the second are on the engine plant.

The author's method of treating the introductory parts is somewhat in evidence all through the book. For instance, he dwells at considerable length on the functions of the boiler, on the storage of heat, the physics of heat transfer and the mechanics of boiler form and stresses. From the latter naturally the book drifts into a discussion of boiler design and construction, including a review of familiar details.

Furnaces, chimneys and necessary boiler accessories are presented from the viewpoint of their effect on the function of the boiler as a heat-absorbing and energy-transfer apparatus. Before the engine room is taken up, the author groups together those plant refinements, or auxiliaries, by which labor or fuel required can be reduced. This class of apparatus includes mechanical coal and ash-handling machinery, mechanical stokers, feed-water heaters, economizers and superheaters. Prof. Hutton pays much attention to firing fuel so as to prevent smoke, to the prevention and removal of scale and to the minimizing of boiler corrosion.

The transition between the two main parts of the book is by a chapter on the piping of pressure to engines and accessories. This contains the theories of size and strength of pipes, which Prof. Hutton has made familiar in his earlier editions, as well as the more practical details of joints, hangers, valves, etc.

The treatment of steam engines proper will appeal to those seeking the historical development more than to those who d… the last word on the tendencies of latest … tice. The author divides steam engines gene… as pressure motors and impulse motors. A … ther outline of reciprocating units is ma… of direct-acting, oscillating-cylinder, trunk … nd back-acting engines—an old classificati… that will not appeal to some teachers and p… cticing engineers. After this some of the kin… tic problems of the steam engine designer ar… scussed—such as effectiveness of crank and … nnecting-rod mechanism, dynamic stresses in … ne parts, inertia and acceleration, etc. The… ollows a discussion of the thermodynamics of … nple and compound engines. Descriptions of … tary engines form a sort of a transition to … e steam turbine.

In the turbine section, Prof. Hutto… takes up the thermodynamics of the impulse … ergy of steam projected against turbine blad… . He describes the earlier work, notably of … e Laval, Stumpf and Dow, and then comes d… n to the two types best exploited in America … he Westinghouse-Parsons and the Curtis.

After this insertion of turbine discu…sions, the author gets back to reciprocating practice and takes up rather superficially the design of foundations, cylinders, pistons, guides, piston and connecting rods, shafts, fly-wheels, valve gearing and governors. Then follows a good descriptive chapter on condensers and a meager four pages on power plant testing.

Throughout the book the author goes somewhat beyond power-station practice in his descriptions. In the sections on boilers several marine and automobile types are taken up. In the engine sections much space is devoted to marine practice and a little to locomotives. Now and then an anachronism exists which the author has either carelessly failed to eliminate in rewriting or to which he clings as a relic of days and doctrines now gone. For instance, the old belief is restated that water containing CO_2 but no air or oxygen will corrode iron. The author makes no statements of the recent researches into electrochemical corrosion which have disproved the foregoing belief.

In the turbine section the divided-flow Parsons turbine is not mentioned, nor is the addition to this type of an impulse section of the Curtis type. The use of low-pressure turbines with high-pressure reciprocating engines is not treated so as to show the possibilities as prominently as seems warranted.

Criticisms, such as made here, relate merely to details. The new edition will undoubtedly hold the popularity of previous editions as a text-book, on account of its adaptability to the requirements of a wide variety of instructors.

THE AMERICAN RAILWAY ASSOCIATION.—Proceedings of the Session Held in Chicago, Ill., Nov. 18, 1908. (W. F. Allen, Secy., 24 Park Place, New York City.) Paper; 7½ × 10¼ ins.; pp. 456 to 599, + xxv.; folding sheets and text illustrations.

Among other committee reports, this volume contains one on the transportation of explosives, together with the rules recommended by the com-

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committee, which rules were adopted by the association. Specifications for Bessemer and for open-hearth steel rails, as adopted April 22, 1908, are also included.

The What and Why of the British Railway Locomotive.

THE RAILWAY LOCOMOTIVE—What It Is, and Why It Is What It Is.—By Vaughan Pendred, M. Inst. M. E. London, England: Archibald Constable & Co. Cloth; 6 x 8⅝ ins.; pp. 310; 94 illustrations in the text. 6s.; American price, $2.40.

The locomotive engine has been described, discussed and analyzed so many times from both the popular and the mechanical points of view that one is apt to take up any new book on the subject with an expectation of finding more or less of the same descriptive matter, the same illustrations of various types of engines, or the same mathematical analysis of design of details. In this present case, however, we find the locomotive treated in a somewhat novel manner. It is considered in the light of a complete machine designed and built for certain work under peculiar and in many ways unfavorable conditions of operation. The sub-title to the book gives an idea of the character of the treatment. The author says in his introduction:

> The books which have hitherto been written about the locomotive engine are all either highly specialized or very "popular." None of them go far into the life of the locomotive engine. The technical treatise deals with the locomotive almost altogether as a machine. • • • To use a metaphor, the locomotive is handled by its authors anatomically, not physiologically.

The book is written in an interesting manner, and is very far from being a dry "treatise." In matters of practice it refers almost entirely to English locomotive practice, but has some reference to American features and American investigations. It is written with a careful view to the needs of the student and of the engineer who is not a specialist in railway or locomotive work. For this reason (among others) mathematical treatment is avoided in the main. It is pointed out that the mathematics of the locomotive are far from being a good introduction to its study. In practice, the theoretical mathematics are modified by existing conditions, as may be seen by a consideration of the behavior of the valve gear on a locomotive running at high speed. The author omits all matters of history and also the development of various types, but discusses the locomotive engine from three points of view: (1) as a vehicle; (2) as a steam generator; (3) as a steam engine.

Starting with the locomotive as a vehicle, we have a general description of the frames (bar, plate and combination), with the way in which the axles and axle-boxes are carried in the frames. The truck is rightly given place as an American invention, although some books claim it as English. Different styles of English four-wheel trucks are briefly described, as well as the radial or traversing axle which is used on many English railways. The action of the truck on curves is also discussed. The question of center of gravity is then taken up. It is shown that an engine with a high center rides more easily and minimizes the stresses in wheels and axles, but that on curves the load on the inner rail is diminished so that if the front end of the engine is moved violently inward and the super-elevation of the outer rail is excessive, the engine will have a tendency to leave the rails. It is further pointed out that the engine does not run on a perfectly smooth and level surface, so that designers have to consider not only the handling of loads, but also the reduction of the effects of the external disturbing agencies due to imperfections of the track.

Wheels, the relation of wheels and rails, counterbalancing, adhesion, and propulsion are all discussed in this portion of the book. The last matter (propulsion) is a discussion of the principles governing the method in which the locomotive is propelled by the admission of steam to its cylinders. This first section of the book occupies some 80 pages.

In considering the locomotive as a steam generator (117 pages), the author naturally begins with the boiler and firebox, but he considers these from the viewpoint of their purpose and has little or nothing to say about details of design. He does, however, show the Drummond firebox with transverse water tubes, which has been used successfully on an English railway. Boiler fittings, smokebox fittings, spark arresters and exhaust nozzles are described, and some arrangements used on English engines are illustrated. Other matters considered in this part of the book are combustion, fuel, water, steam and the superheating of steam. As to this last, it is shown that there is great diversity of opinion as to whether the increase of volume by superheating has any economic value, or whether it is counterbalanced by a reduction of temperature. Dr. Garbe, of the Prussian State Railways, is an exponent of the former theory. The author is inclined to the opinion that superheating does not present many practical advantages under the conditions of locomotive working in England.

The consideration of the locomotive as a steam engine occupies about 106 pages, and opens with a description of the cylinders, valves and valve gear. As to the credit for the Stephenson valve-gear, Mr. Pendred believes that while Howe did invent it, the device was impracticable as invented. But Stephenson, as an engineer, saw the principle underlying the inventor's design (but not compreheded by the latter), and so produced a valve gear "which is immortal among mechanical devices." The Walschaert valve gear is shown to be based on principles which are in many respects identical with those of the Stephenson gear. Its advantages over the latter (for large engines) in point of reduced weight are not mentioned, and perhaps are not obtained on ordinary English engine. The Joy radial gear is described also. Slide valves and piston valves are discussed. The latter are considered mainly in regard to compounding, but in this country they are used extensively on simple engines.

Compound locomotives are dealt with very briefly, for the reason that they are little used in England. No reference is made to foreign practice in this matter. The limitations of compounding as applied to locomotive engines are reviewed. Chapters are devoted to tenders and brakes. Another is devoted to tank engines, as this type of locomotive is used very extensively on English railways. It has been claimed that tank engines are specially liable to derailment, but this is disputed by Mr. Pendred, who presents diagrams showing the number of derailments of tank engines and tender engines for a term of years. The running-shed (or round-house) work is reviewed, and a brief closing chapter reviews the performance or work of the locomotive. In this it is stated that while from the early days of railways it has been understood that large driving wheels and high speed go together, the relations were not reduced to a sound basis until some ten years ago, when investigations were undertaken by Prof. Goss, of Purdue University.

The book is distinctly a descriptive review of the locomotive engine as a working machine, and shows the relations of its design and construction to the conditions under which it works. It presents the general principles embodied in the engine, together with some of the special features of its construction. It certainly gives to the engineering reader and the student a better general idea of the locomotive and its work than is given in many a book of greater pretensions. The book is of compact and handy size, is well printed in large, clear type, and the illustrations are clear and well lettered.

LECTURE-NOTES ON THE THEORY OF ELECTRICAL MEASUREMENTS.—Prepared for the Third-Year Classes of the Cooper Union Night-School of Science. By William A. Anthony, Late Professor of Physics, Cooper Union. Third edition, revised by Albert Ball, Assistant Professor of Physics and Applied Electricity, Cooper Union. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 4¾ x 7½ ins.; pp. 122; text illustrations. $1.

In the revision of the late W. A. Anthony's notes for this third edition Prof. Ball has added several problems in each chapter. There is also some additional matter on condenser capacity and its determination.

Half the book takes up the bases of different systems and units of mass, force, energy, etc., and the relations between electrical units. The rest of the book is given over to the explanation of practical measurements of potential, current and resistance, and to the laws of the heating, chemical and magnetic effects of the electric current.

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Electric Motors.

ELECTRIC MOTORS.—Their Installation, Control, Operation and Maintenance. By Norman G. Meade. New York: McGraw Publishing Co. Cloth; 4¾ × 7½ ins.; pp. 159; 126 illustrations in the text. $1, net.

Mr. Meade has evidently written this book for the shop man who does not understand electric motors, but finds himself in need of knowing more about them, theoretically and practically. Of course the book does not stand alone in this field, nor can it be called exactly novel. It would seem that if any man understood enough mechanics to be familiar with the resolution of forces he could assimilate the theoretical parts.

The first chapter, on the theory of motors, is largely given up to a discussion of armature reaction in direct-current motors and rotating fields in alternating-current machines. The author then separates the direct-current from the alternating-current motors and describes the more common types—the series, shunt and compound machines and the inter-pole and variable magnetic-circuit motors. The construction of induction motors is given much space.

After leaving the motors themselves a great variety of commercial types of controllers, for all sorts of work, are described. It is remarkable that the author does not mention any of the multiple-voltage direct-current speed controls for machine-shop work. Next, the reader is switched on to the uses of motor-generators and then to the planning and installing of shop wiring for motor drives.

There are many operating hints on testing out motors to see if they are in order, on sparking remedies, on starting and on the care of commutators and bearings. The chapter on repairs largely describes the making of a new commutator with a little matter on rewinding armatures. The book is completed by a collection of formulas and a table of the properties of copper wires.

CERTAIN CONCLUSIONS CONCERNING TYPHOID FEVER IN THE SOUTH, AS DEDUCED FROM A STUDY OF TYPHOID FEVER IN RICHMOND, VA.—Ernest C. Levy, M. D., Chief Health Officer, Richmond, Va., and Allen W. Freeman, M. D., Assistant Health Commissioner of Virginia. (Read at the 36th annual meeting of the American Public Health Association, held at Winnipeg, Manitoba, Aug. 25-28, 1908.) (Reprinted from The Old Dominion Journal of Medicine and Surgery, Vol. VII., No. 5, November, 1908.) Paper; 6 × 9¼ ins.; pp. 39; text illustrations and one folding plate.

This notable contribution to the study of the origin and the means of control of typhoid fever confirms in large measure the conclusions reached within the last few years regarding the relation between water-supply and typhoid at Washington, D. C. In fact, the conclusions of this study go somewhat further than those reached in the Washington investigation, in that they seem to clear the water-supplies of both Richmond and Washington to a marked degree, and put the responsibility for the high typhoid in each city almost wholly upon other causes. Thus the plotting of the typhoid curves for a series of years in each city shows that the curves, generally speaking, follow each other very closely, indicating that the rise and fall of typhoid in Washington was perhaps not properly attributed to decrease and increase, respectively, in the period during which water was stored prior to consumption.

During this period of change in water-supply conditions at Washington, the supply at Richmond remained unchanged, and in general there has been no change in the Richmond supply for 20 years, except a natural increase in pollution of the surface supply due to an increase in population on the drainage area, and a decrease in the storage owing to increased consumption without increase of reservoir capacity. After reviewing all the probable factors entering into the prevalence of typhoid in Richmond, the authors conclude as follows:

The death date from typhoid fever in Richmond, certainly for the past few years, has been almost entirely the "residual," or "prosodemic" rate of northern cities, made larger than in the North by reason of the greater length and intensity of the hot season, during which, both North and South, there is normally a marked increase in the typhoid death rate. A considerable part of this residual rate in Richmond is due to the large number of dry closets.

The authors also think that the conditions affecting the prevalence of typhoid in Richmond are largely the same throughout the South. Of general conditions influencing the prevalence of typhoid fever, the authors say:

We are reduced, so far as the writers can see, absolutely to the theory that there must be some little understood influences of a very widespread character, varying from year to year, which play a more important role in the epidemiology of typhoid fever than has as yet been recognized.

Similar climate is the most obvious of the common conditions, and, had time permitted, we would have endeavored to secure reliable statistics from other southern cities. This, however, would have been a task of no mean proportions, as southern statistics are notoriously unreliable. Over one month's time of one man was taken in getting our Richmond figures from the original death certificates, and, obviously, we had no means of doing this in other cities.

The need of further study of residual typhoid is urged toward the end of the report. At the same time, stress is laid on the importance of protecting both the water and milk supplies.

THE DAILY NORMAL TEMPERATURE AND THE DAILY NORMAL PRECIPITATION OF THE UNITED STATES.—By Frank Hagar Bigelow, Professor of Meteorology, in Charge of the Division of Meteorological Records. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Bulletin R, Weather Bureau: Washington, D. C. Pub. Doc. Paper; 9 × 11½ ins.; pp. 186. $1.75.

The figures here given for daily normal temperatures relate to available records in about 177 cities and towns. The maximum period covered is from 1873 to 1905, inclusive. Each city is given a table which shows the normal temperature for each day, the mean for each month, and also the annual mean for the period. Some of the rainfall normals cover a slightly longer period, or from 1871 to 1906, inclusive.

A total of about 175 places are included under Precipitation, and the tabular presentation follows the scheme just outlined for temperature. The temperature normals were deduced by scaling from curves of monthly normals. After obtaining the daily normals, the monthly means were taken, "and in case of any discrepancy between these monthly means and the original monthly normals the curve was slightly adjusted, so that these two monthly means should be in very close agreement." The daily normals for precipitation were obtained by first plotting daily means, but as the resulting curve was generally rough or else consisted of broken lines, and inasmuch as perhaps two or three centuries of percipitation records would be required to eliminate excessive local percipitations due to more or less accidental storms at a given place, instead of using the mean values indicated by the curves the mean values for eleven successive dates were taken. For instance, for Jan. 6 the mean for Jan. 1-11, inclusive, was taken. For stations of short record the means were corrected by comparisons with station records of longer periods in the vicinity.

Publications Received.

ACCURATE TOOL WORK.—By C. L. Goodrich, Department Foreman, Pratt & Whitney Co., and F. A. Stanley, Associate Editor "American Machinist," Author of "The Hill Kink Books" and "American Machinists' Handbook." New York and London: Hill Publishing Co. Cloth; 6 × 9¼ ins.; pp. 217; 221 illustrations in the text. $2, net.

ASPHALTS.—Their Sources and Utilizations. Asphalt for Dustless Roads; Recent Improvements in Asphalt Industries; Together with Addenda Treating on General Waterproof Construction. By T. Hugh Boorman, Civic Engineer and Asphalt Expert. New York: William T. Comstock. Cloth; 6½ × 10 ins.; pp. 168; plates and text illustrations. $3.

DIE AUSNUTZUNG DER WASSERKRAEFTE.—Technische und Wirtschaftliche Grundlagen. Neuere Bestrebungen der Kulturländer. By E. Mattern, Regierungsbaumeister, Kgl. Wasserbauinspektor. Second edition, greatly enlarged. Leipzig, Germany: Wilhelm Engelmann. Paper; 6½ × 9½ ins.; pp. 652; 256 illustrations in the text.

BEGINNINGS IN INDUSTRIAL EDUCATION.—And Other Educational Discussions. By Paul H. Hanus, Professor of the History and Art of Teaching in Harvard University. Boston and New York: Houghton Mifflin Co. Cloth; 4¾ × 7½ ins.; pp. 190. $1, net.

BOARD OF ESTIMATE AND APPORTIONMENT OF THE CITY OF NEW YORK.—Report of the Chief Engineer, on the First International Road Congress, Held at Paris, Oct. 11-18, 1908. (Nelson P. Lewis, Chief Engineer.) Paper; 6½ × 10 ins.; pp. 25.

COMPARATIVE FINANCIAL STATISTICS OF THE CITIES AND TOWNS OF MASSACHUSETTS.—First Annual Report, Covering Municipal Fiscal Years Ending between Nov. 30, 1906, and April 1, 1907. By the Chief of the Bureau of Statistics of Labor (Charles F. Gettemy). Boston, Mass.: Pub. Doc. (No. 79.) Cloth; 6 × 10 ins.; pp. lii. + 299.

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DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY.—Annual Report to the Secretary of the Interior for the Fiscal Year Ended June 30, 1908. George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 99; two folding maps.

DISEASES OF OCCUPATION.—From the Legislative, Social and Medical Points of View. By Thomas Oliver, M. D., F. R. C. P., Physician, Royal Infirmary, Newcastle-upon-Tyne; Professor of Physiology, Durham University. New York: E. P. Dutton & Co. Cloth; 5½ × 9 ins.; pp. xix. + 427. $3.

EXPRESS BUSINESS IN THE UNITED STATES, 1907.—Special Reports, Bureau of the Census; S. N. D. North, Director. Washington, D. C.: Pub. Doc. Paper; 9 × 11½ ins.; pp. 28.

GEORGIAN BAY SHIP CANAL SURVEY.—Report on the Precise Levelling, Years 1904 to 1907. Sessional Paper No. 19a. Department of Public Works of Canada; Hon. William Pugsley, Minister. Ottawa, Can.: Pub. Doc. Cloth; 6½ × 10 ins.; pp. 157; text illustrations and one folding map.

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ILLINOIS BUREAU OF LABOR STATISTICS.—26th Annual Coal Report, 1907. Also the 9th Annual Report of the Illinois Free Employment Offices, for the Year Ended Sept. 30, 1907. David Ross, Secretary, Springfield. Springfield, Ill.: Pub. Doc. Cloth; 5½ × 8¾ ins.; pp. 418 + 84.

INDUSTRIAL EDUCATION.—The Annals of the American Academy of Political and Social Science. Issued Bi-Monthly. Vol. XXXIII., No 1, January, 1909 Emory R. Johnson, Editor. Philadelphia, Pa.: The Academy (36th and Woodland Ave.). Paper; 7 × 10 ins.; pp. 224. $6 per year; $1 per number.

INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS.—Proceedings of the Annual Convention Held at Columbus, Ohio, Aug. 25-28, 1908. Roanoke, Va.: The Association (James McFall, Secy.). Paper; 5¾ × 9¼ ins.; pp. 200; illustrated.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION.—Proceedings of the 11th Annual Meeting Held at Pittsburg, Kans., Oct. 8-9, 1908. Newton, Kans.: The Association (James D. Nicholson, Secy.). Paper; 5¾ × 9¼ ins.; pp. 110.

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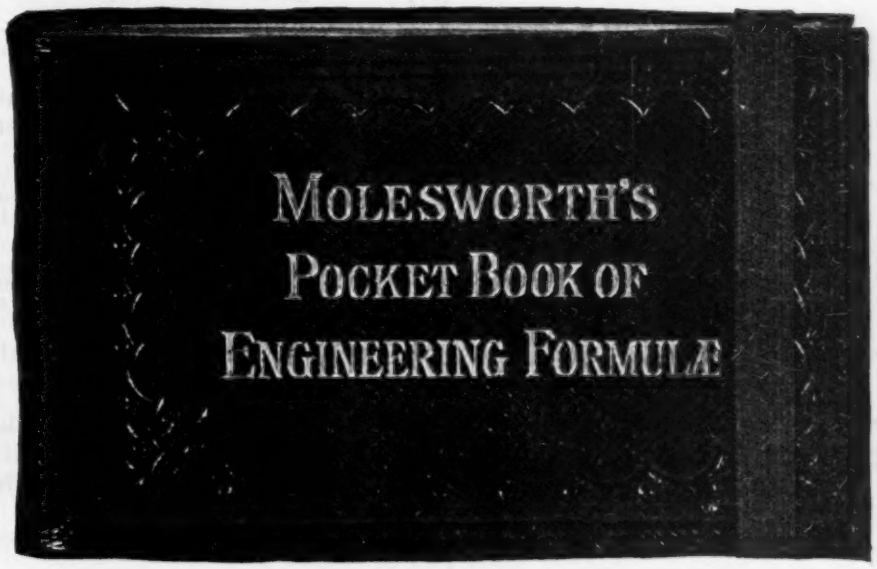

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TRAVELING ENGINEERS' ASSOCIATION.—Proceedings, Annual Meeting Held at Detroit, Mich., Aug. 25-28, 1908. Buffalo, N. Y.: The Association (W. O. Thompson, Secy., 829 Elmwood Ave.). Leather; 5¾ × 8¾ ins.; pp. 346; folding plates and text illustrations.

USES FOR EUCALYPTUS LUMBER AND TIMBER.—Second edition. Bulletin No. 3, The Forestry Society of California (Hon. G. B. Lull, Chairman Advisory Board). Los Angeles, Cal.: The Society (514 Stimson Building). Paper; 6 × 8¾ ins.; pp. 12.

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